

(PCT Article 36 and Rule 70)

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/JP2005/003111

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following _____, which is the language of a translation furnished for the purposes of:
- ☐ international search (Rule 12.3 and 23.1(b))
- ☐ publication of the international application (Rule 12.4)
- ☐ international preliminary examination (Rule 55.2 and/or 55.3)
2. With regard to the **elements** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:
- ☐ the international application as originally filed/furnished
- ☒ the description:
- pages 1-3, 8-17, 21, 23, 28, 33, 35 as originally filed/furnished
- pages* 4-6, 6/1, 7, 7/1, 18-20, 22 received by this Authority on 04.10.2005
- pages* _____ received by this Authority on _____
- ☒ the claims:
- nos. 2-9 as originally filed/furnished
- nos.* _____ as amended (together with any statement) under Article 19
- nos.* 1, 10-21, 24-35 received by this Authority on 04.10.2005
- nos.* 22, 23 received by this Authority on 12.05.2006
- ☒ the drawings:
- sheets Fig. 1-3 as originally filed/furnished
- sheets* _____ received by this Authority on _____
- sheets* _____ received by this Authority on _____
- ☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages _____
- ☐ the claims, nos. _____
- ☐ the drawings, sheets/figs _____
- ☐ the sequence listing (*specify*): _____
- ☐ any table(s) related to sequence listing (*specify*): _____
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages _____
- ☐ the claims, nos. _____
- ☐ the drawings, sheets/figs _____
- ☐ the sequence listing (*specify*): _____
- ☐ any table(s) related to sequence listing (*specify*): _____

* If item 4 applies, some or all of those sheets may be marked "superseded."

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Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement																					
1.	<p>Statement</p> <table><tr><td rowspan="2">Novelty (N)</td><td>Claims</td><td>1-35</td><td>YES</td></tr><tr><td>Claims</td><td></td><td>NO</td></tr><tr><td rowspan="2">Inventive step (IS)</td><td>Claims</td><td></td><td>YES</td></tr><tr><td>Claims</td><td>1-35</td><td>NO</td></tr><tr><td rowspan="2">Industrial applicability (IA)</td><td>Claims</td><td>1-35</td><td>YES</td></tr><tr><td>Claims</td><td></td><td>NO</td></tr></table>	Novelty (N)	Claims	1-35	YES	Claims		NO	Inventive step (IS)	Claims		YES	Claims	1-35	NO	Industrial applicability (IA)	Claims	1-35	YES	Claims		NO
Novelty (N)	Claims		1-35	YES																		
	Claims		NO																			
Inventive step (IS)	Claims		YES																			
	Claims	1-35	NO																			
Industrial applicability (IA)	Claims	1-35	YES																			
	Claims		NO																			
2.	<p>Citations and explanations (Rule 70.7)</p> <p>Documents:</p> <p>Document 1: WO 03/016599 A1</p> <p>Document 2: Chemical Society of Japan (Ed.), Daiyonban Jikken Kagaku Kouza 19, Tankasuiso Halogen Kagoubutsu, Maruzen, 1992, pages 438 to 446</p> <p>Explanation:</p> <p>(1) The Inventions Set Forth in Claims 1 to 35</p> <p>The inventions set forth in claims 1 to 35 are not disclosed in documents 1 or 2, and are therefore novel.</p> <p>(2) The Invention Set forth in Claims 1 to 9</p> <p>The invention set forth in claims 1 to 9 does not involve an inventive step in the light of document 1.</p> <p>Comparing the invention set forth in claim 1 with the invention set forth in document 1, the structural formula represented by chemical formula (I) in the latter contains a polyacene compound represented by chemical formula (I) of the former, but the latter does not specify the polyacene compound represented by chemical formula (I) of the former, which constitutes a difference. The two inventions are identical in other respects.</p> <p>However, document 1 sets forth a compound in which a</p>																					

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variety of different substituents have been introduced into R_2 , R_3 , R_7 and R_8 (corresponding to R_1 to R_4 in chemical formula I set forth in claim 1) in chemical formula (I), and compounds having fluorine substituted for R_1 , R_4 , R_6 and R_9 in chemical formula (I) (corresponding to X in chemical formula (I) set forth in claim 1), together with the method of synthesizing said compounds. Document 1 also indicates that R_2 , R_3 , R_7 , R_8 and R_1 , R_4 , R_5 , R_6 , R_9 , R_{10} are both functional groups (page 7, lines 22 to 24); and that these compounds are useful as organic semiconductor thin films, therefore it would be easy for a person skilled in the art to conceive of having the compound set forth in chemical formula (I) described in claim 1 of this application serve as the compound set forth in document 1.

In addition, optimizing reaction conditions such as reaction temperature and the reagent in accordance with differences in and the existence of substituents when synthesizing a compound is a matter which a person skilled in the art could accomplish as necessary.

Next, the effect offered by the invention set forth in claim 1 is examined below.

Document 1 indicates that the carrier mobility of a transistor formed using the compound represented by chemical formula (I) falls within the range of 0.05 to 0.35cm²/V·s, and comparing these values to the case wherein the compound of the invention set forth in claim 1 is used, the values set forth in document 1 are equal to or greater than the values of the invention set forth in claim 1 of this application, therefore the carrier mobility of the compound of the invention set forth n

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claim 1 of this application does not offer a particular effect.

In addition, document 1 sets forth a method of applying a solution (0.3wt%, for example) with a similar concentration when the compound set forth in claim 1 of this application is used, as a method of forming a thin film of a compound represented by chemical formula (I), therefore the solubility with respect to the solvent of the compound of the invention set forth in claim 1 of this application and the compound set forth in document 1 is understood to be equivalent.

Moreover, the description of this application indicates that the compound of the invention set forth in claim 1 has a halogen element in the molecular structure, and therefore has superior oxidation resistance compared to compounds which do not have halogen elements, but the description does not disclose specific data concerning said effect, and the effect of operation of halogen elements in a molecular structure with respect to oxidation resistance properties is unclear, therefore the invention set forth in claim 1 does not offer an effect with respect to oxidation resistance which would be unexpected to a person skilled in the art.

The same applies to the invention set forth in claims 2 to 9.

(3) The Invention Set forth in Claims 10 to 21

The invention set forth in claims 10 to 21 does not involve an inventive step in the light of document 1 cited in the international search report.

Document 1 sets forth an organic semiconductor thin film having compound represented by chemical formula (I);

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an organic semiconductor thin film having the principal axis of the molecules of said compound represented by chemical formula (I) oriented in a direction perpendicular to the surface of the substrate; an organic semiconductor device at least partly constituted by said organic semiconductor thin film; and a transistor.

(4) The Invention Set forth in Claims 22 to 33

The invention set forth in claims 22 to 33 does not involve an inventive step in the light of documents 1 and 2 cited in the international search report.

Document 1 sets forth a method of producing 5,7,12,14-tetrafluoropentacene, wherein pentacenetetron is reduced before being tosylated and fluorinated.

Comparing the invention set forth in claim 22 and the invention set forth in document 1, the two differ in the following aspects: the former is a method wherein in the first stage reaction, a polyacenequinone is reduced to form a hydroxypolyacene derivative, while in the latter there is no mention of said hydroxypolyacene derivative (difference 1), and the former is a method wherein in the second stage reaction, the aforementioned hydroxypolyacene derivative is halogenated and aromatized, while the latter is a method in which tosylation and fluorination is carried out (difference 2), in the former, the raw material polyacenequinone derivative is a structure wherein at least part of R_1 to R_4 in chemical formula (I) has a specific functional group, while the latter does not have said functional group (difference 3). The two inventions correspond in all other aspects.

With regard to difference 1, document 1, as stated

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	<p>above, sets forth a method of reducing pentacenetetron, and normally a hydroxyl group is generated by the reduction of a carbonyl group, therefore it is understood that in the invention set forth in document 1, the reduction of pentacenetetron generates a corresponding hydroxypolyacene derivative.</p> <p>With regard to difference 2, as a means of producing halogenated compounds by halogen-substituting a hydroxyl group, a method of directly halogenating the hydroxyl group and a method of initially tosylating a hydroxyl group and subsequently halogenating the product are both known (document 2), and determining whether or not to initially tosylate the hydroxyl group when halogenating the hydroxyl group is a matter which a person skilled in the art could determine as necessary, taking into account the type and yield of raw materials, and the efficiency of the production method. Hence, the tosylation set forth in document 1 is a step which could be selected for the halogenation of the hydroxyl group, therefore it would be easy for a person skilled in the art to constitute the method set forth in document 1 as a method not containing a tosylation step.</p> <p>In addition, document 1 does not specifically disclose aromatization, but as described above, is a method of producing 5,7,12,14-tetrafluoropentacene by tosylation and fluorination, therefore fluorination and aromatization are understood to be effectively carried out.</p> <p>With regard to difference 3, document 2 specifically discloses compounds having functional groups in R₂, R₃, R₇ and R₈ (corresponding to R₁ to R₄ of chemical formula (I) set forth in claim 22 of this application), and in the</p>

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series of production steps set forth in document 1, in cases where R_2 , R_3 , R_7 and R_8 are alkyl groups or the like, there is no reason why a reduction reaction or fluorination reaction would have an effect on these groups, therefore it would not be particularly difficult for a person skilled in the art to have a raw material polyacenequinone derivative serve as a compound having a functional group in at least part of the positions of R_2 , R_3 , R_7 and R_8 in the production step set forth in document 1.

When doing so, optimizing the reaction conditions such as reaction temperature and the reagent in accordance with differences in and the existence of functional groups is a matter which a person skilled in the art could accomplish as necessary.

The same applies to the invention set forth in claims 23 to 33.

(5) The Invention Set Forth in Claims 34 and 35

The invention set forth in claims 33 and 34 does not involve an inventive step in the light of document 1 cited in the international search report.

Document 1 sets forth a display unit provided with a large number of pixel surfaces, wherein organic semiconductor devices or transistors comprising organic semiconductor thin films containing the compound set forth in chemical formula (I) are provided to each pixel.

In addition, document 1 sets forth a display device wherein the electrode, dielectric layer and semiconductor layer provided to an organic semiconductor device or transistor are formed by printing or applying a liquid.